Market trend and

Measurement system AMI / AMR

July , 2013

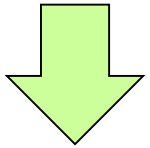
- Introduction of mounting technology
- Market trend
- Target customer
- A MI and AMR

Introduction of mounting technology

Introduction of recent mounting technology

The new mounting technology with a semiconductor device is required for mobile and downsized electronic equipment.

The demands for reliability evaluation among material and mounting maker are increased to realize these technologies.



Purpose of the evaluation

Joint section reliability / Insulation reliability

Measurement system AMI / AMR are best solution for evaluation.

1. Mobile electric devices

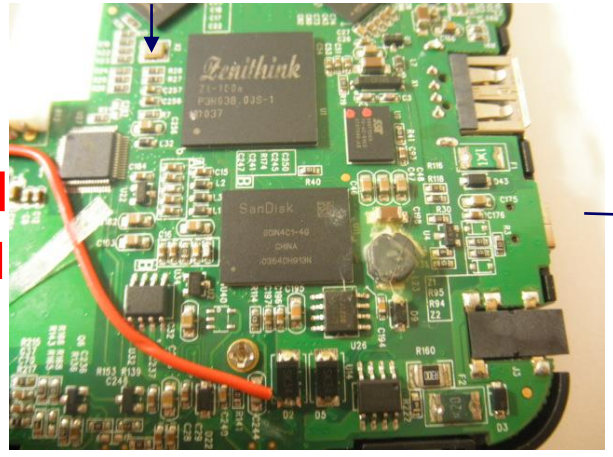
Various mounting technologies are applied.

LCD

TAB

Conductive adhesive

Anisotropic conductive film



Mother Board

MCM/SIP

BGA mounting

Buildup PCB

Underfill resin

CSP

Wire bonding

1-1. CSP (Chip size package or Chip scale package)

Package is made same size of tip size on device. Electrode are bonded by solder ball, same as BGA on mounting side.

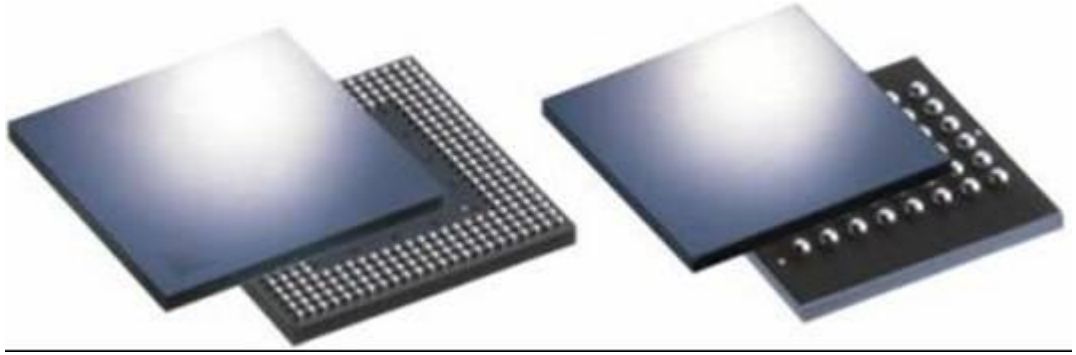
Advantage

Smaller mounting space than BGA

Point of issue

Crack on the ball occur same as

BGA by physical heat stress.



CSP

Evaluation methods

It is impossible to do visual inspection.

Thermal shock test + Continuously condactive measurement are required.

(TSA+AMR)

1-2. Build up (Substrate) board

The most often used circuit carriers are copper-foil covered organic insulator plates. Multilayer substrates are built-up with circuit and through holes by the photo-dielectric embedding exposure technology. The layers are built up on each other and not discrete multilayer substrates are laminated. The core board can be insulator coated copper foil or aramid fiber enhanced epoxy resin.

Advantage

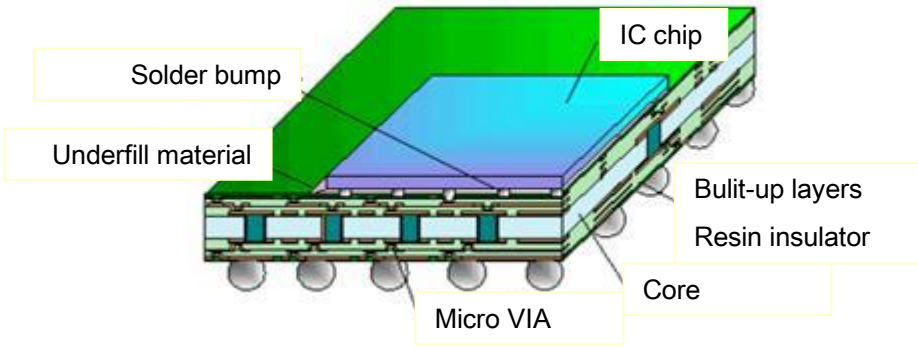
It is required for the mounting of flip tip and CSP technology by smaller through hole and narrower circuit lines.

Point of issue

Due to thin insulator between each layers, it is important to secure insulation and reinforcement of through holes.

Evaluation methods

It is important Conductive, Insulation and Electromigration measurement.



Cut section built-up board

1-3. Flip Chip mounting technology

For packaging semiconductor device on the board, to be jointed circuit on the semiconductor device and circuit board via solder bump.

Advantage

Reducing mounting area

Applied high frequency signal due to shorter wiring

Point of issue

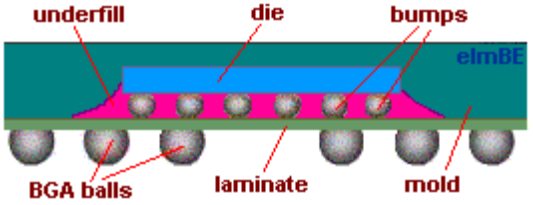
Crack by physical stress by heat stress

(Difference of coefficient of thermal expansion)

Adoption of underfill resin to absorb mechanical stress

(Required migration evaluation)

Another methods of connection; Wire boding (Conductive adhesive), ACF (Anisotropic conductive film)



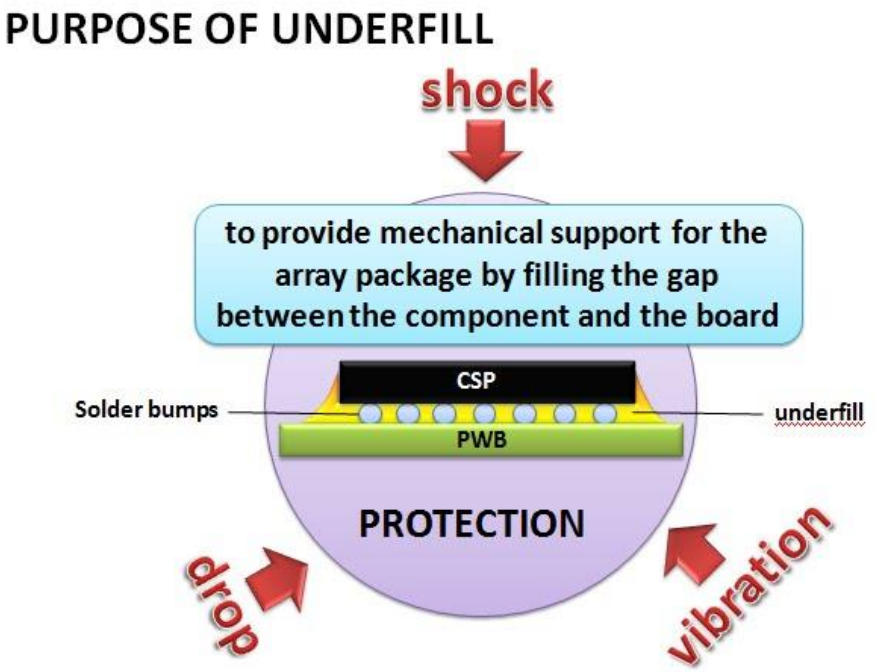
Flip chip mounting

1-4. Underfill resin

Underfill is the process of applying a specially engineered epoxy to fill the area between the die and the carrier. Underfill resin materials are designed to control the stress on the solder joints.

This stress is caused by either the difference in thermal expansion between the silicon die and the carrier or physical stresses caused by vibration or drop shock.

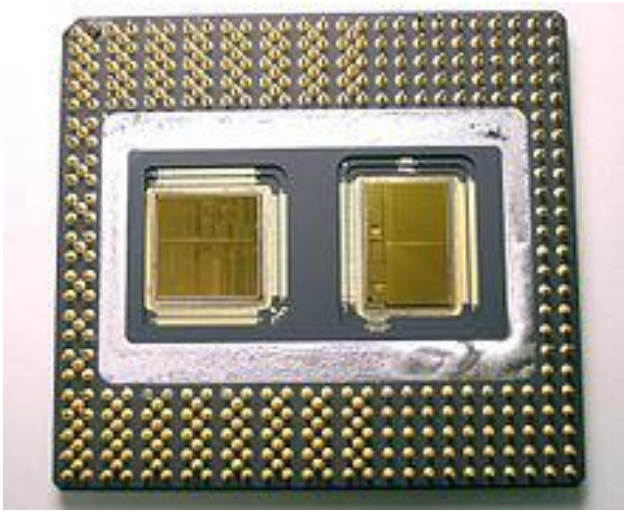
Once cured, the underfill absorbs the stress, reducing the strain on the solder bumps, greatly increasing the life of the finished package. Underfill is typically applied using a capillary flow process where material is dispensed next to a bonded flip chip and allowed to "wick" under the die.



Underfill resin

1-5. SIP (System In Package)

A system-in-a-package or system in package (SiP), also known as a Chip Stack MCM, is a number of integrated circuits enclosed in a single package or module[clarification needed]. The SiP performs all or most of the functions of an electronic system, and are typically used inside a mobile phone, digital music player, etc. Dies containing integrated circuits, may be stacked vertically on a substrate. They are internally connected by fine wires that are bonded to the package. Alternatively, with a flip chip technology, solder bumps are used to join stacked chips together.



Ex. Pentium Pro

Two pieces of chip are placed side by side designed based on SIP structure.

The left side chip is for arithmetic processor main unit. The light side is for secondary memory cache.

2. ECU (Engine Control Unit)

Plenty of electronics parts are equipped on the cureent car.

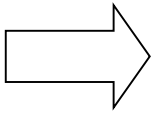
(Navigation, Sensors, Engine and other controller)

- Performance under savior environmental condition is very important
- Environmental friendly and efficient car
- Transition period to integrity control

*Intelligent Transport Systems

To save the life from accident

Securing Safety reliability



Strict request for quality, durability and reliability

2.1 Digitized parts are introduced to automotive

Front monitoring/ Lane keep camera

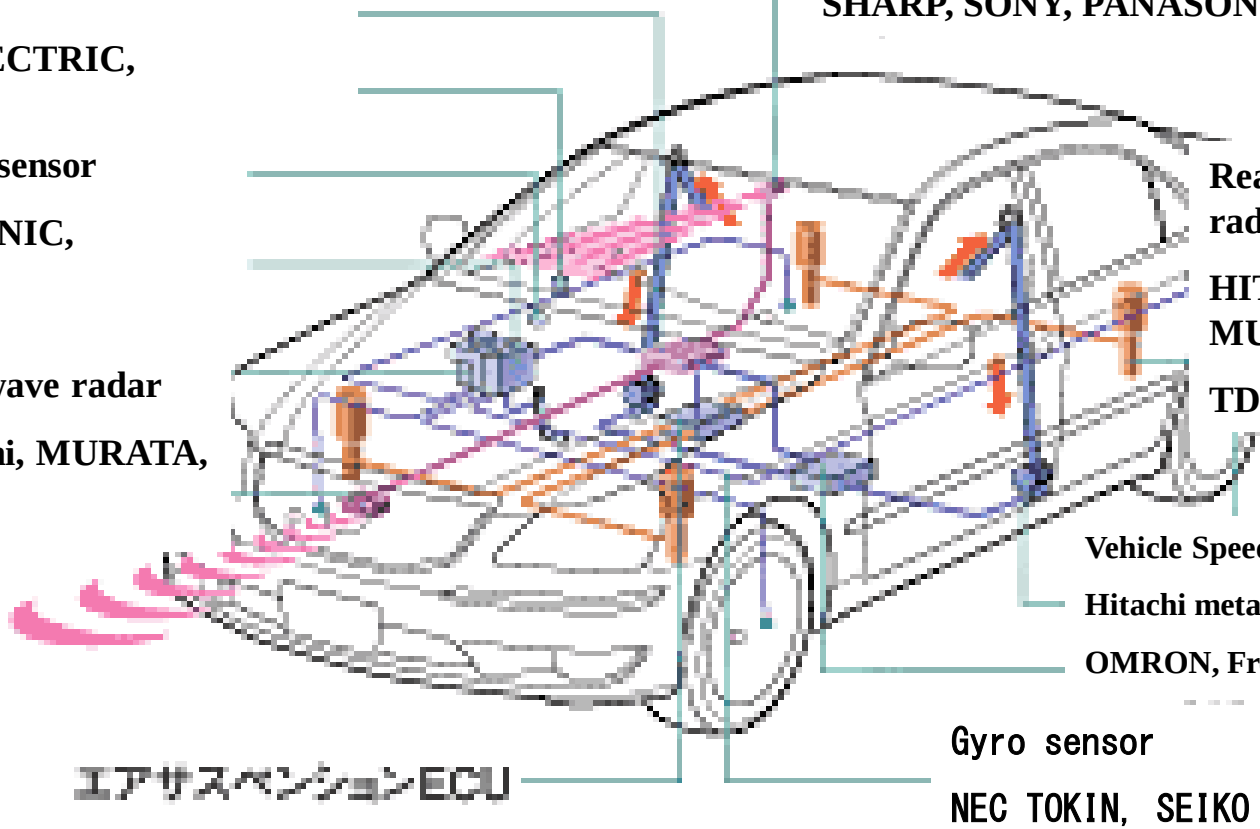
SHARP, SONY, PANASONIC, NIKON, OLYMOUS

Rudder angle sensor

WAKO, ALPUS ELECTRIC, PANASONIC

Hydraulic pressure sensor

OMRON, PANASONIC, OLYMPUS



Rear side millimeter wave radar

HITACHI, Mitsubishi, MURATA,

TDK, FUJITSU

Forward millimeterwave radar

HITACHI, Mitsubishi, MURATA,

TDK, FUJITSU

Vehicle Speed sensor

Hitachi metal, Analog device, DENSO

OMRON, Free scale

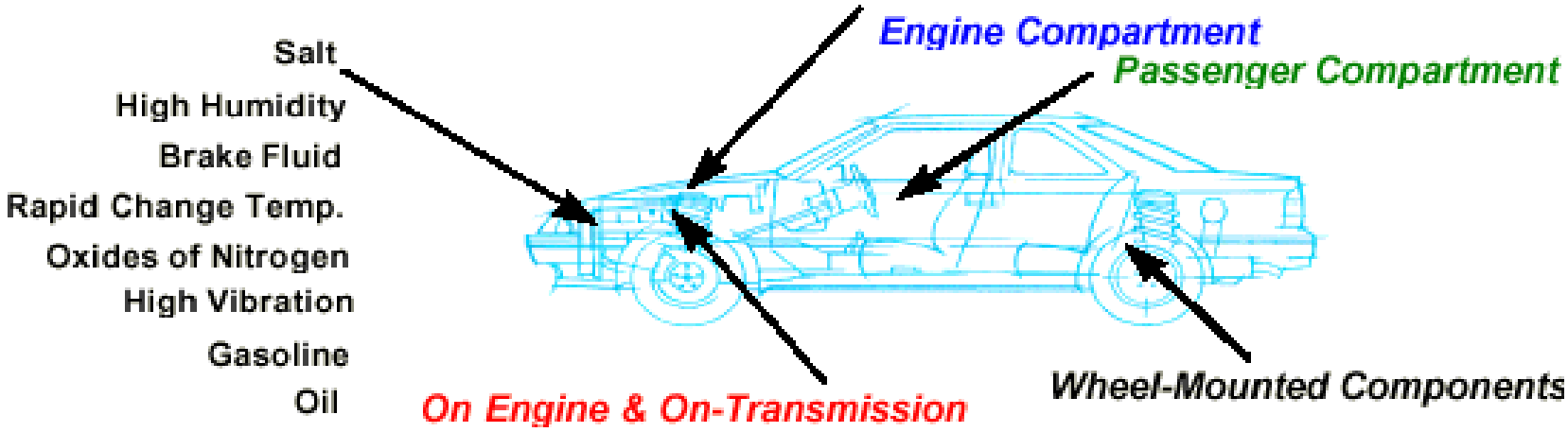
Gyro sensor

NEC TOKIN, SEIKO EPSON, Siliconsensing

More than 100pcs sensors are usedin a car

The source; TOYOTA home page add to K.Takahashi

2-2. Test temperature for ECU (Engine Control Unit)



Component Location	Operating Temperature (Baseplate)
Passenger Compartment	-40 °C to 85 °C
Engine Compartment	-40 °C to 125 °C
On-Engine and On-Transmission	-40 °C to 140 °C
Wheel-Mounted Components	-40 °C to 250 °C

NEMI Technology Roadmaps 2002

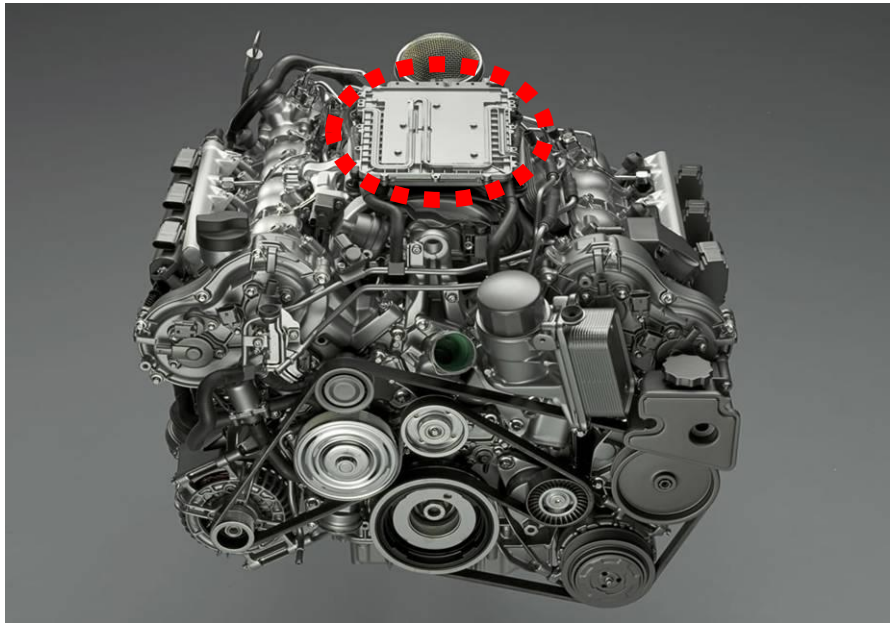
2-3. Product trend for ECU in Engine room

Contents		2006	2010	2016
Size W×D×H (㎜)	MIN	120×90×30	100×60×10	80×40×10
	MAX	160×130×22	140×100×20	120×90×15
Weight（g）	MIN	300	140	50～150
	MAX	500～600	350～500	250～400
Volume (cc)	MIN	320～400	150～200	50～100
	MAX	350～460	200～280	100～160
Power Consumption (W)	MIN	3	3	3
	MAX	4.5～30	8～50	11～50
Drive voltage(V)	MIN	14	14	14
	MAX	14、42	14、42	14、42
HEV Drive voltage(V)	MIN	500	500	500
	MAX	600～800	600～1000	～ 1200
IC device Drive voltage(V)	MIN	3	3	1.5～2
	MAX	5	5	3

Resource: JEITA Roadmap 2007

2-3. digitized automotive parts

ECU mounted on Engine



Picture: Mercedes Benz CLS 350 CGI

ECU is used in engine and transmission to reduce wire harness/production cost.

Photo: Motor Magazine, No.603, 2005

High temperature resistance and miniaturize technology

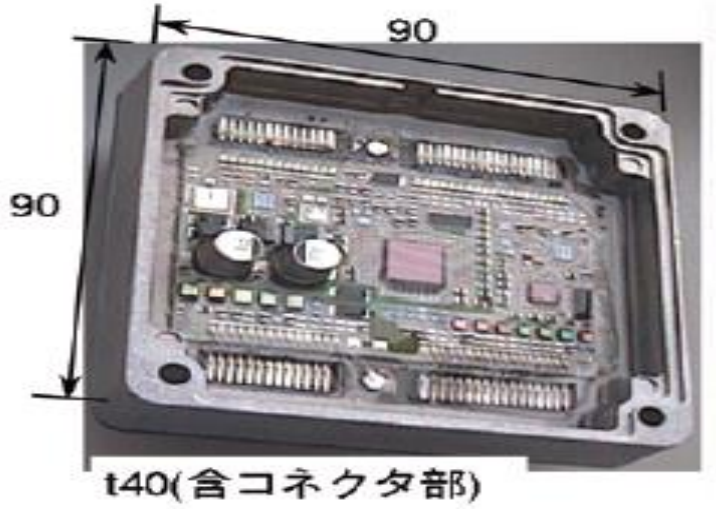


Fig. 14 Appearance of hybrid ECU

＜New Technology＞
-Almina board（Material R&D）
・High Temp. spec semiconductor development（Semiconductor technology)
・Bear chips Jisso technology（Jisso Technology）

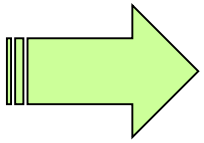
DENSO Technical Review Vol.8, No.2,2003

Market trend

< Why we expect market growth? >

- Demands for high density chip mounting

  Smaller device, Higher function, Low voltage, Higher process speed

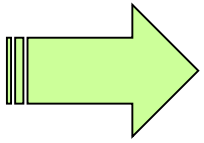
  

  Further requirement for higher density chip

  From two-dimensions to three dimensions mounting

- Demand on power semiconductor device for energy market

  Power semiconductor devices are semiconductor devices used as switches or rectifiers in power electronic circuits (switch mode power supplies for example). They are also called power devices or when used in integrated circuits, called power ICs.

  Evaluation of Insulation applied high voltage

  Reliability evaluation for power semiconductor device

Market trend

TABLE 2. 2004 NTI 100

	MAKER	COUNTRY
1	Ibiden	Japan
2	Nippon Mektron	Japan
3	CMK	Japan
4	SEMCO	Korea
5	Unimicron	Taiwan
6	Shinko Electric Industry	Japan
7	Hitachi Chemical	Japan
8	KB Group	HKG
9	Daeduck Group	Korea
10	Nanya	Taiwan
11	Korea Circuit Group	Korea
12	Fujikura	Japan
13	Multek	US
14	Compeq	Taiwan
15	Wus	Taiwan
16	Sanmina-SCI	US
17	Viasystems	US
18	AT&S	Austria
19	LG Electronics	Korea
20	MMM-3M	US

HDD Mobile PC

Revenue of Global Rigid PCB Manufacturers, 2010 (Top 20) (USD million)

Manufacturer	2009	2010
TRIPOD	1,013	1,361
UNIMICRON	980	1,194
TTM	582	1184 (acquired Meadville)
CMK	959	1,043
MEIKO	743	900
IBIDEN	747	832
FOXCONN PCB	750	810
ViaSystems	350	764
MULTEK	660	720
COMPEQ	569	707
HANNSTAR	587	696
AT&S	519	647
Elec & Eltek	435	599
Hitachi Chemical	520	550
GCE	433	493
TPT	375	483
Chin Poon Industrial	394	447
LG INNOTEK	340	443
WUS	334	442
Nan Ya PCB	205	329

40th Jump up

HDD Mobile PC

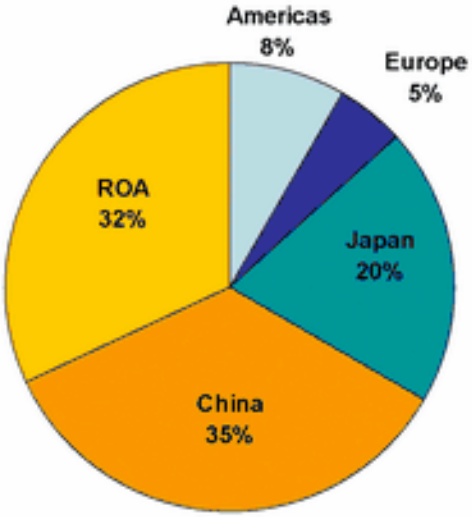
27th Jump up

FOR EV

Data by Research In China

Global PCB Market by Region

2009 Global Market Share



ROA = Asia excluding China and Japan

Regional Growth History & Projections

$ in billions

Region	2000	2009	2010	2011	2012e	CAGR '09-'12
Americas	$10.9	$3.4	$3.7	$3.8	$3.6	1.8%
Europe	$6.7	$2.0	$2.2	$2.2	$2.2	2.6%
Japan	$11.3	$8.3	$8.7	$9.0	$8.5	1.1%
China	$3.4	$14.3	$16.6	$18.2	$19.6	11.2%
ROA	$8.7	$13.1	$15.0	$16.3	$16.0	7.0%
World	**$41.0**	**$41.1**	**$46.2**	**$49.5**	**$49.9**	**6.8%**

Source: Prismark May10

2009 Global Ranking

Top 10 World PCB Makers

Rank	Company	Revenue est.	Rank	Company	Revenue est.
1	Unimicron	$1,734	6	CMK	$978
2	Ibiden	$1,732	7	KB PCB Group	$923
3	Nippon Mektron	$1,446	8	SEMCO	$895
4	TTM (includes Meadville pro forma)	$1,131	9	Young Poon Group	$887
5	Tripod	$1,028	10	Nanya PCB	$848

Represents approximately 29% of total world PCB output

Top 5 North America PCB Makers

Rank	Company	Revenue est.
1	TTM	$506
2	DDi (includes Coretec)	$222
3	Sanmina	$150
4	EIT	$130
5	Merix	$115

Represents approximately 32% of total Americas PCB output

Top 5 China PCB Makers

Rank	Company	Revenue est.
1	Tripod	$907
2	KB PCB Group	$870
3	Foxconn	$750
4	Meadville Group	$624
5	Multek	$590

Represents approximately 26% of total China PCB output

Note: 2009 estimated revenues for PCB segment only
Total TTM – Meadville pro forma revenue for 2009 $1.2 billion

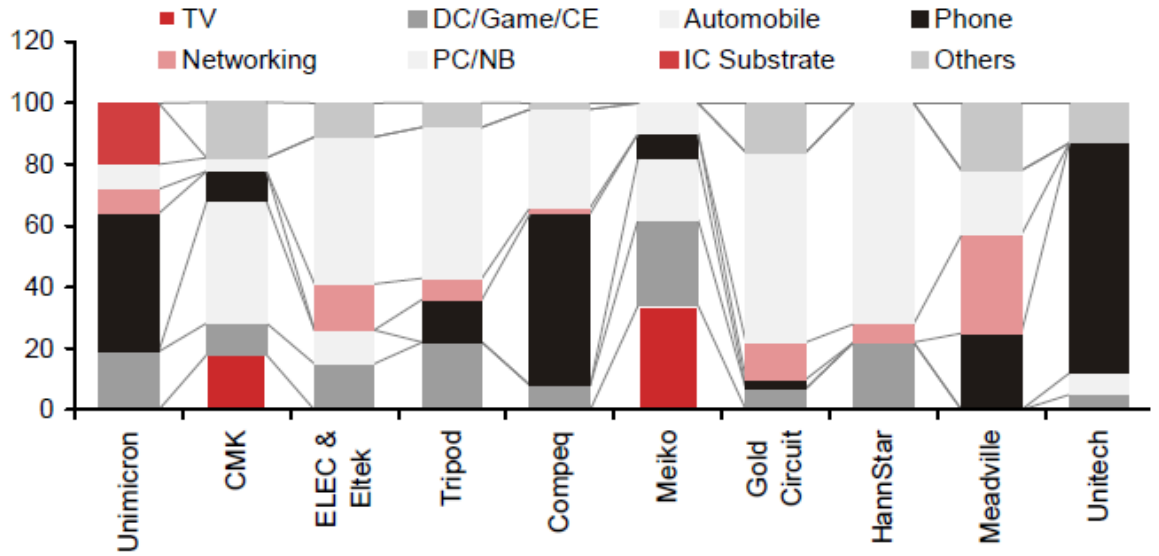
NT Information January 2010

Exhibit 26. Market breakdown by application (US$mn)

Application	Market	Estimated PCB market size	PCB maker 1st	2nd	3rd
PC	Taiwan	450	Hannstar (40-45)	Gold Circuit (20)	Tripod (10)
Automotive	Japan/US/Europe	130	CMK (10)	Panasonic ED (5)	Meiko (5)
MobilePhone	Europe/Korea	300	Unimicron (21)	Compeq (15)	SEMCO (5-6)
TFT-LCD	Japan/Korea/Taiwan	100	Meiko (20-25)	TPT+Yang An (20-25)	Tripod (20-25)
Base Station	Europe/China	50	Meadiville		
Memory	Taiwan		Tripod (30-35)	Simmtech	
CPU	US	200	Ibeden (40)	Shinko Electronics (30)	NGK+Nan Ya PCB (30)
GPU	US	50	PPT (45)	Nanya PCB (22)	Unimicron (18)

Source: Nomura

Exhibit 28. Major PCB vendors' sale breakdown by application



Source: Use some refer from Taiwanese PCB companies' annual report

Customer

Our customer

Business Segment	Department	Main purpose	Manufacturing product
Manufacturer of assembled products	Mounting technology, Production technology, Product development, R&D, QA	PB free, Insulation, conductive resistance evaluation, Mounting line design, Mounting technology development, Material evaluation, Circuit design, Parts evaluation, Reliability assurance	PC relating, Digital video, camera, Mobile, PDA, Car use electronics, Home appliance etc.
Electronics parts	Product technology, Material development, R&D, QA	Characteristic evaluation, Material evaluation, Reliability evaluation during development, Reliability assuarance	Capacitor, Resistance, Connectors, LCD, Coils etc.

Business Segment	Department	Main purpose	Manufacturing product
Semiconductor device	Package development, QA	Package level reliability evaluation	Semiconductor, Power device, Semiconductor device etc.
Electric material/ Chemical products	R&D, QA	Material development evaluation, Reliability assurance	Electric conductive adhesive, Anisotropic electric conducting layer, Electric conducting pastes, Solder, Flux, Resist material, Underfil material, Circuit board material (resin) etc.
Circuit board manufacturer	Design, QA	Circuit design evaluation, Reliability assurance	Relating circuit board, Build-up circuit board, Alumina substrates, SiC substrate

Ion Migration (Insulation resistance) evaluation system

AMI

★ What it the purpose of the system ?

The system for evaluating insulation resistance on the circuit board continuously under the environmental test which is inside of environmental test chamber

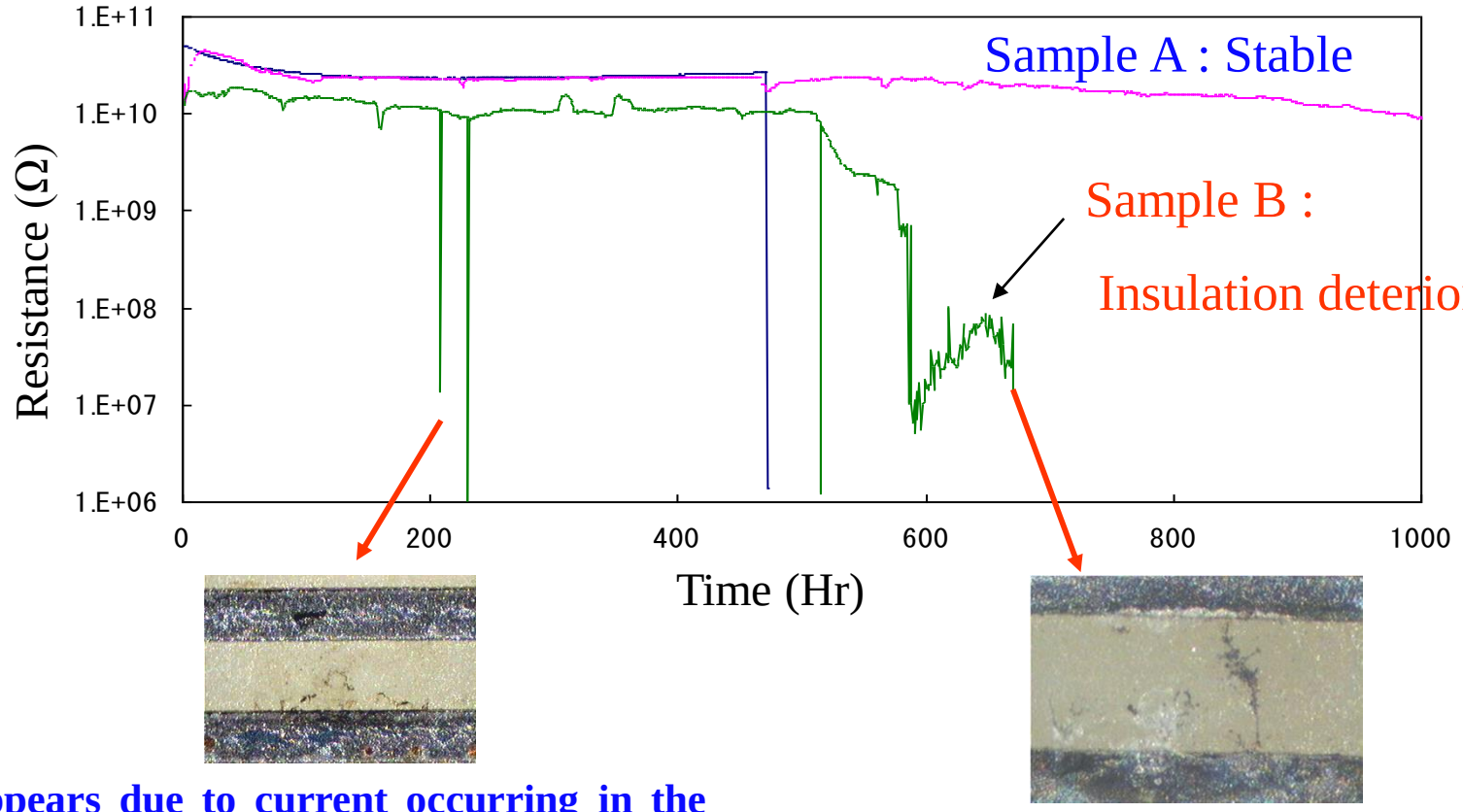
★ Back grounds of test demands

Ion migration is the typical phenomenon of insulation failure known from long time ago. By the recent technology trend of smaller packaging for electric devices or high density packaging for semi conductive device, the short circuit with ion migration has been common issues .

Other usage of the system : Capacitor voltage proof test, Insulation leak test

The usage is not only evaluation of circuit board but also voltage proof and leakage evolution for electric parts. And, demands of evaluation for up trance circuit is also increased. The evaluation system for revers polarity measurement is available in our system line-up.

Ion Migration (insulation resistance) Evaluation System : AMI



Disappears due to current occurring in the instant of a short circuit, and recover high insulation

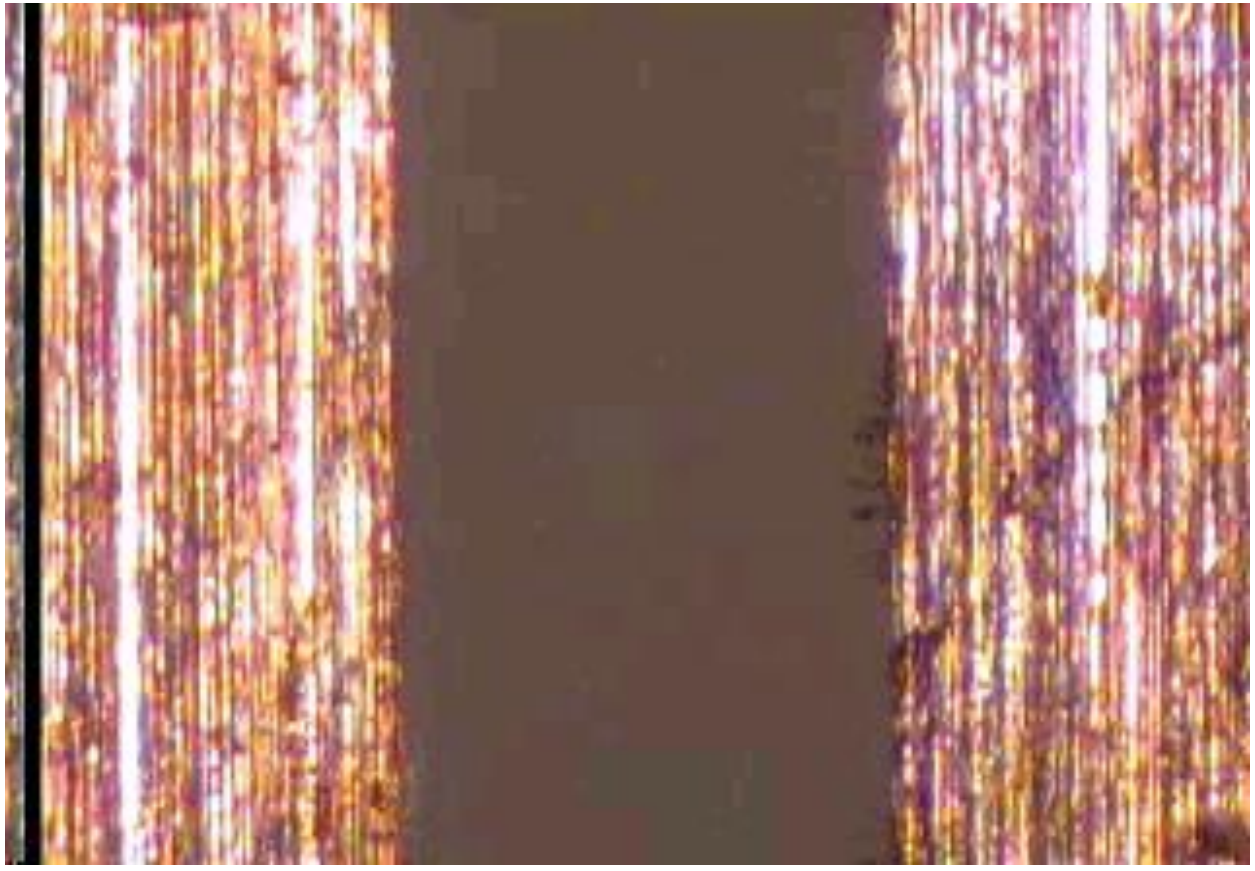
Short circuit by migration growth

Specimen = Solder Flux (on IPC-B-25 comb pattern)

Test Conditions = +85℃-85%RH, 50VDC

Copper migration *(Interactive video picture)*

Anode (+)



Cathode (−)

Electrode — **Insulation gap = 0.3mm** — **Electrode**

3V/DC bias, Dripping 1μL of ion exchange water onto gap

Copper (Cu) electrode, Substrate = glass cloth epoxy (FR-4)

Conductor resistance evaluation system

A M R

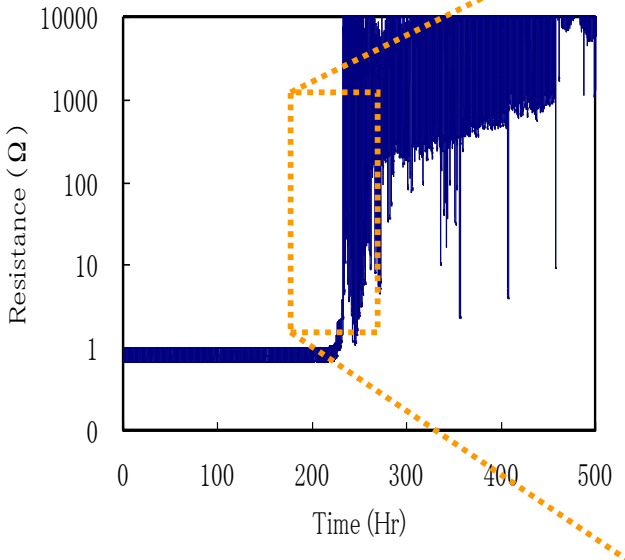
★ What is the purpose of sytem?

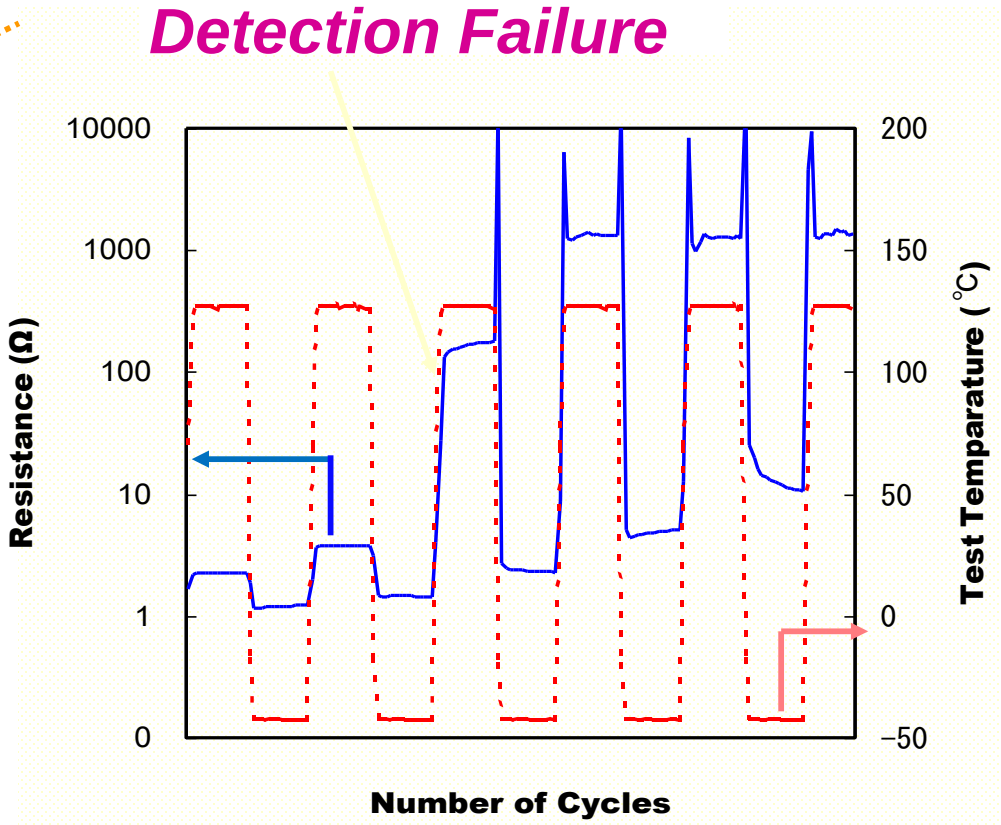
The system for evaluating slight resistance change of conductor resistance continuously at junction of parts under the environmental test which is inside of environmental test chamber

★ Crack phenomenon

Crack at junction point occurs due to difference of thermal expansion rate between materials used for parts. Mechanical stress mass to the point of junction points or corners by the thermal cycling and make cracks on them.

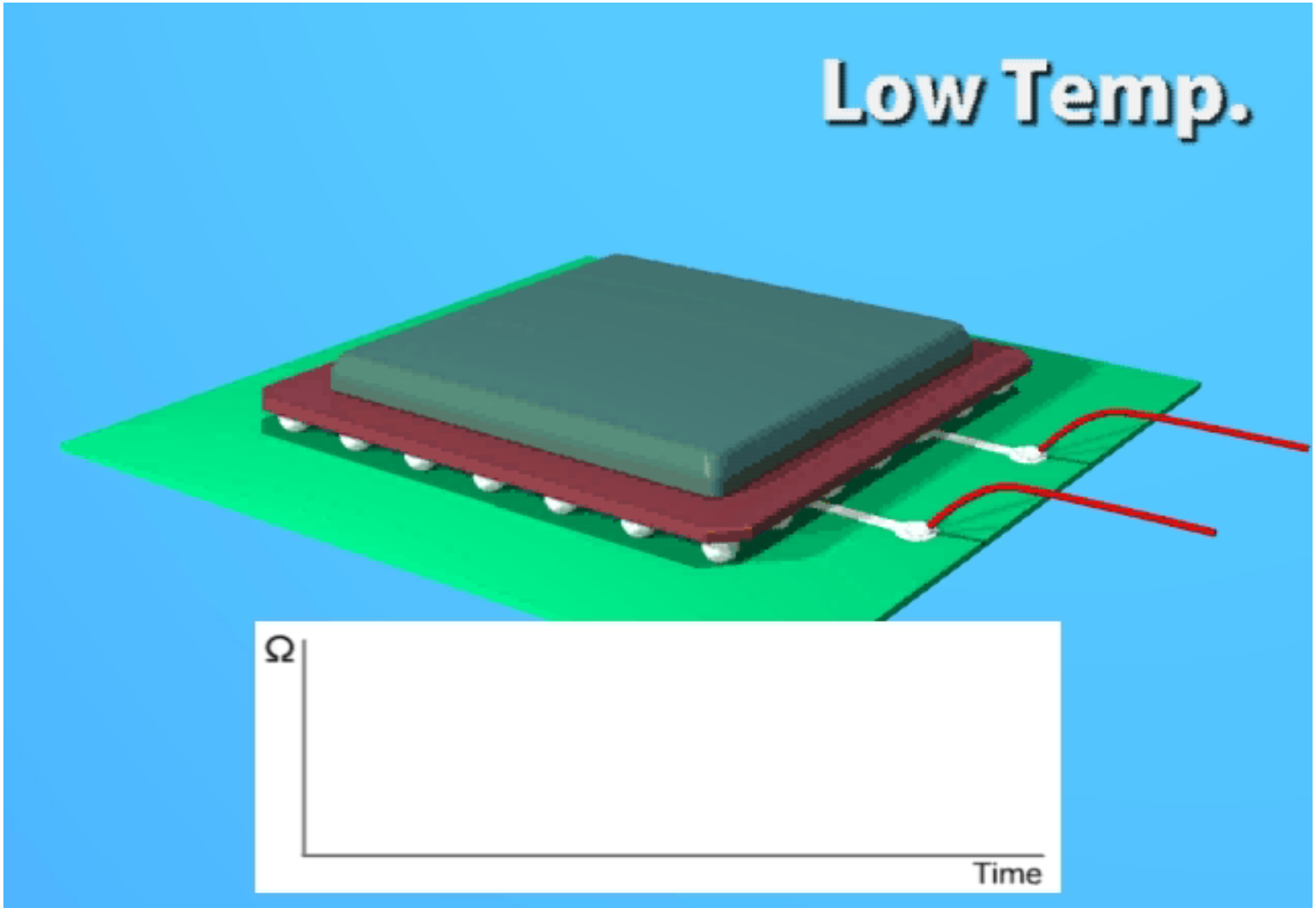
Conductor resistance evaluation system : AMR





Change in Resistance of Solder Joints
during Thermal Cycle Test

Conductor resistance evaluation system : AMR



1) AMI + Weiss/Voetsch WC/VC3 : linkage operation

2) AMI High Voltage application : 1kV 2.5kV

Please ask customized specification to your ESPEC distributors.